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APOLLO MONTHLY PROGRESS REPORT

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NAS9-150

January 1, 1964



Paragraph 8.1, Exhibit I

Report Period
November 16 to December 15, 1963

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NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

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PROGRAM MANAGEMENT

STATUS SUMMARY

Two successful parachute recovery drop tests were conducted at El Centro during the report period. The purpose of the tests was to observe the turn-around and stability of the vehicle during drogue descent. Details are contained in the Docking and Earth Landing subsection of the Development portion of this report (p 18). Boilerplate 13 completed manufacturing operations and was delivered to test operations. It is scheduled for shipment to the Florida facility during the next report period.

A series of water drop tests was initiated at the Downey impact test facility to provide data for a reliability analysis of water landings.

The command module of mock-up 9 has been shipped to Tulsa. A stress analysis of the service module mock-up is being performed to determine if a strengthening of the structure is necessary. If modifications are required, they will be completed prior to shipment.

CONTRACT STATUS

Contract Change Authorizations Received from NASA

Contract Change Authorization (CCA) 114 authorizes the refurbishment of boilerplate 6 to meet the drop test requirements of boilerplate 3 for performance of parachute recovery tests.

CCA 115 authorizes a revision of the abort initiation of the launch escape system. The abort initiation is to be accomplished by utilizing circuitry which contains a hotwire or loss-of-power initiating system.

CCA 116 amends Exhibit I, Documentation Requirements, with the additional requirement of a Signal Definition Report.

New Procurements

In anticipation of a contract change identifying General Electric as associate contractor for prelaunch automatic checkout equipment (PACE), S&ID is preparing plans for its technical and administrative interfaces with NASA and GE. A proposed interface coordination operating procedure will be ready for NASA review during the next period.



PACE Command and Response Systems

Facility surveys of five sources which submitted proposals for the digital test command system (DTCS) were completed. Bid proposals were received December 6, 1963. Evaluation of proposals is scheduled for completion during the next report period.

Bidding is in process for the interleaver and subcommutator components of the response system.

LOGISTICS

Operations Control

The December Logistics Support Conference between NASA and S&ID was completed December 12. Conference minutes will be distributed by December 18, 1963.

The Honeywell support plan has been accepted, and approval correspondence has been submitted to be sent to the subcontractor.

Supply Support

The first High Value Spares Conference was conducted on December 12. NASA indicated the desire to refine spares requirement computations by applying factors for high-population items (items with a high quantity per end item). This factor would reflect the decline in failure rate per part as the parts population increases.

Logistics Engineering

The GSE planning and requirements document was distributed.

NASA has accepted 15 items of GSE for support of boilerplates 12 and 13, respectively.

Training

Apollo logistics training participated in the Engineering design review meeting for the Apollo part-task trainer (APTT) during the report period. The department presentation was on the minimum training requirements to be met by the Apollo part-task trainer.

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During the report period, all support manuals for boilerplate 16 were delivered to NASA to support the vehicle shipping date to MSFC. These consisted of the spacecraft familiarization handbook, systems maintenance manual, ground support equipment manuals, transportation and handling manual, and description manual.

Test Site Support

The expediting support of Test Site Operations for the period of November 16 to December 15 is as follows:

Table 1. Expediting Support of Test Site Operations

	AMR	ATO and Test Prep	WSMR	El Centro	Total
Backlog as of November 16	6	188	176	1	371
Test Site requirements received	7	797	107	14	925
Requirements shipped	9	820	181	15	1,025
Requirements outstanding	1	134	82		217
Requirements cancelled	3	31	20		54

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DEVELOPMENT

AERODYNAMICS

A study was made of the launch escape subsystem (LES) separation capability during the maximum dynamic pressure (q) portion of the launch flight (approximately 12,500 to 40,000 feet altitude). The study was made for both thrusting and nonthrusting S-I boosters. The results of the study confirm the requirement that the booster thrust be terminated in order to achieve satisfactory LES separation during this maximum-q period of flight. An increase of 30,000 pounds in LES thrust over the present 155,000 pounds would be required to achieve LES separation if S-I thrust is not terminated during maximum q.

Tests of the tower flap and command module lee-side antenna roll effects were completed for Mach numbers 3 through 6 in AEDC wind tunnel A. Static stability tests using the FS-2 model were completed for Mach numbers 3 and 3.4 in the Ames 8-foot-by-7-foot wind tunnel. Tests were run for three configurations: the command module and LES, the command module and tower flap, and the command module only. The test results are being evaluated.

MISSION DESIGN

A lighting indicator was constructed to study the prevalent lighting conditions at six specific trajectory events in a lunar landing mission: earth launch, translunar injection, lunar landing, transearth injection, entry, and earth landing.

Preliminary trajectory-shaping requirements for entries from lunar missions were defined for MIT guidance subsystem design analysis. These requirements were based upon entry monitor subsystem (EMS) monitoring logic (corridor, excessive-g, and critical atmospheric exits). Monitoring for critical exit conditions imposes the greatest path-shaping constraints on the primary guidance. The criteria used in defining these constraints were the allowance of 5000 nautical miles of ranging capability under extreme conditions and the minimization of EMS maximum range potential. The primary guidance shaping constraints included the effects of a $3\text{-}\sigma$ EMS design tolerance assumed in the most adverse manner.

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MIT indicated that the requirements for a 5000-nautical-mile range could be met, to achieve the desired touchdown conditions within the shaping constraints, by modifying the entry guidance. If supercircular lateral ranging is required prior to reaching circular speed, lateral logic modifications will be required also.

The design flight plan for a 1-day unmanned earth orbital spacecraft mission was completed. The flight plan consists of the following:

- Mission description
- Mission schematic
- Sequence of events
- Boost and entry profiles
- Mission planview
- Representative subsystems test timeline
- Command, tracking, and telemetry coverage

This design mission was based on the use of the Saturn IB booster to insert the spacecraft into a 105-nautical-mile, nearly circular orbit at an initial flight azimuth of 105 degrees. The spacecraft and S-IVB attitude control capability will be evaluated during the first orbit; then the S-IVB will be jettisoned. During the next 13 revolutions, the spacecraft subsystems, including the electrical power (EPS), communications and instrumentation, environmental control (ECS), reaction control (RCS), service propulsion (SPS), stabilization and control (SCS), guidance and navigation (G&N), and in-flight test subsystems, will be tested. On the fourteenth revolution, deorbit and test of the earth landing subsystem will occur. The G&N entry mode will be used to direct the spacecraft toward a predetermined landing site near Ascension Island. Projected Gemini ground operational support subsystem capability was used to determine up-command, tracking, and telemetry coverage for this design mission.

CREW SYSTEMS

The Apollo prototype diet was evaluated in an 8-day test using three test subjects who were not confined but continued their normal work activities. The subjects were given performance and oxygen consumption tests (by means of a treadmill and pulmonary function analysis) and lean body mass and body compartment water evaluations (with isotopes of tritium and bromine). The results showed insignificant changes in weight and physiology. Quantitative data analysis will continue in order to assess biochemical alterations which may have occurred within normal ranges and which are undiscernible in terms of performance or general well being. Complete test results will be released in early 1964.

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The crew transfer concept was tested in the special S&ID mock-up of the command and service module tunnel (see Figure 1). The ability of test subjects to remove the probe and drogue or the stem and cable docking mechanism from the command module tunnel was evaluated. Test results and the documenting film were presented at a docking interface panel meeting at NASA-Houston, November 19 and 20.

STRUCTURAL DYNAMICS

Tests on the one-tenth scale flotation model, with the command module tunnel shortened to one-half of its original volume, confirm the effects calculated for the second stable flotation position. The heel angle over a wide range of c. g. positions was 10 to 12 degrees more than the unmodified configuration because of the loss of buoyancy at a considerable distance from the c. g. This implies 1 foot less of freeboard on the actual vehicle and a consequent increase in the possibility of taking water in the side hatch.

Experiments to measure righting moment versus heel angle for the one-tenth scale model were completed. Results were within 10 to 15 percent of calculated values over the entire range of interest. Actual heel angles at the two stable flotation positions confirmed the accuracy of the calculations.

The measurement of strains on the 50-degree and 70-degree panels of the service module shell structure during acoustic excitation at fundamental panel frequencies was completed. Preliminary results indicate that no large strains resulted from the acoustically induced vibration. Detailed data evaluation will establish basic structural modes and evaluate vibration transmission characteristics from panel to panel, and from panels to shear webs. The acoustic test facility will be modified to provide a broad-band random excitation instead of the present discrete frequency siren.

A series of analytical studies of docking mechanisms, including tether devices, ring-cone arrangements, and a probe and drogue subsystem, were completed. Each device, with its variations, was examined for a number of initial and end conditions. Each mechanism was found to have distinct advantages for certain combinations of conditions. The probe and drogue subsystem showed the best ability to secure a latch over the broadest range of parameters.

STRUCTURES

Final stress analysis of the LES dual mode explosive bolt included bending loads in the bolt due to horizontal shear on the LES tower. The

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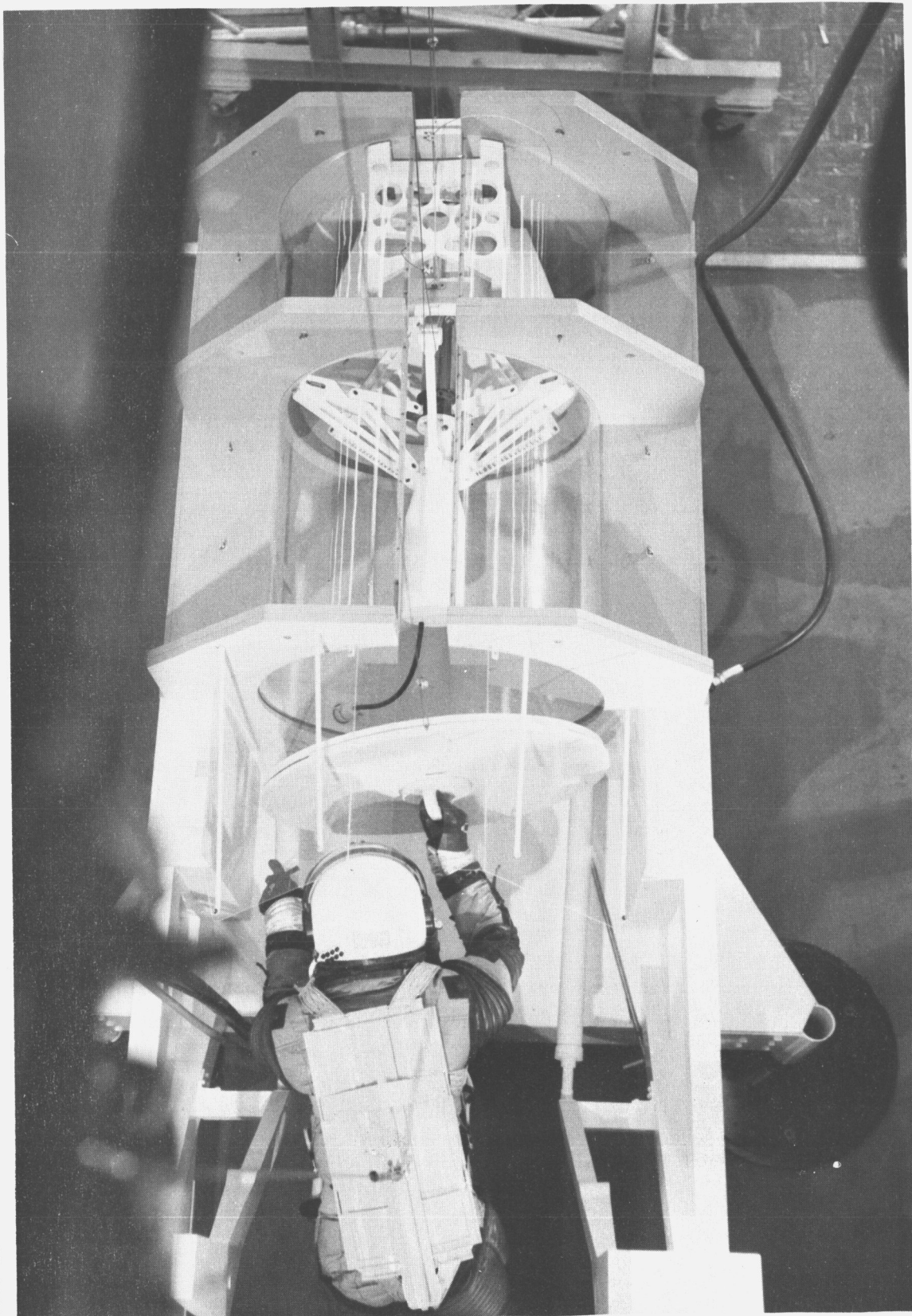


Figure 1. Command Module Tunnel Study

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dual mode bolt will be heat-treated at 200,000 to 220,000 psi and will be subjected to a combined tension and bending load instead of a pure tension load.

The exterior surfaces of the command module on boilerplate 12 were covered with a cork facing for thermal protection. The cork thickness is 0.16 inches on the forward heat shield and 0.125 inches aft of the forward cover interface plane. The cork on the crew compartment is extended onto the aft heat shield and scarfed at the edges. The step at the forward cover interface is faired to prevent aerodynamic problems.

Revision of the command module forward end was begun, following an engineering review board held during the report period. Changes are to include provisions for jettisonable docking mechanism, reduced parachute volume, enlarged tunnel diameter and shortened length, increased thruster force, and use of a full-length hard-boost protective cover in conjunction with insulation and thermal paint.

A study was made to determine the increase in total vehicle weight required to retain the adapter shell for use as a meteoroid bumper during translunar flight. The increase in structural weight was found to be approximately 150 pounds—in propellant weight, 1600 pounds.

FLIGHT CONTROL SUBSYSTEM

Stabilization and Control Subsystem

The SCS procurement specification was up-dated to the D revision and the SCS statement of work was revised. Acceptance testing of the 13 end items comprising the SCS was completed for functional model A.

The revised command programmer sequencer requirements for the unmanned suborbital spacecraft 009 flight were completed.

Three different proposed circuits to shut off the RCS command module and service module jets, if a driver amplifier fails, are being breadboarded for evaluation.

Electronic Interfaces

A formal proposal to NASA requesting a study program to determine the type and extent of redesign required to solve the command module lower equipment bay problems is being prepared. The use of vertical

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coldplates will provide for better heat dissipation. The redesign will also result in greater accessibility for in-flight maintenance of the lower equipment bay.

Drawings for the engineering model of the caution and warning unit were completed and all components were received. The chassis was completed and fabrication was started on the final module and wiring harness.

Flight Systems Analysis

The present shape and location of the VHF-2kmc scimitar antennas, the umbilical, and the command module vents will produce aerodynamic rolling moments during entry. Intermittent firing of the command module reaction control subsystem will be required to correct these effects, resulting in additional propellant consumption and reduced roll control authority.

Location and control of the Y-axis c.g. for spacecraft 009 (suborbital) and 011 (earth orbital), both of which are constant roll-angle entry missions, appear to be sufficiently flexible to reduce the aerodynamic moments to an acceptable level. However, for superorbital entry, location of the Y-axis c.g. does not appear to be sufficiently flexible, and relocation of the external protuberances may be necessary.

TELECOMMUNICATIONS

Communications

Five engineering (E) models of the data storage equipment units were completed and acceptance-tested. E-models 1 and 2 are being subjected to environmental proof tests in the design verification test phase; E-model 3 will be used for subsystems evaluation tests; E-model 4 will be used in house spacecraft 001 (boilerplate 14); E-model 5 will be subjected to off-limit tests in the design verification test phase to determine design margin of safety. Due to schedule requirements, the fast dump capability will not be included in these five E-models but will be incorporated in the development (D) models. Figures 2 and 3 depict, respectively, the tape transport side and the under chassis containing the electronic modules of E-model 1.

Central timing equipment (CTE) E-model 1 was completed and acceptance-tested.

Instrumentation

A master measurement requirements document was released for Apollo vehicles. Measurement requirements were released for boilerplates

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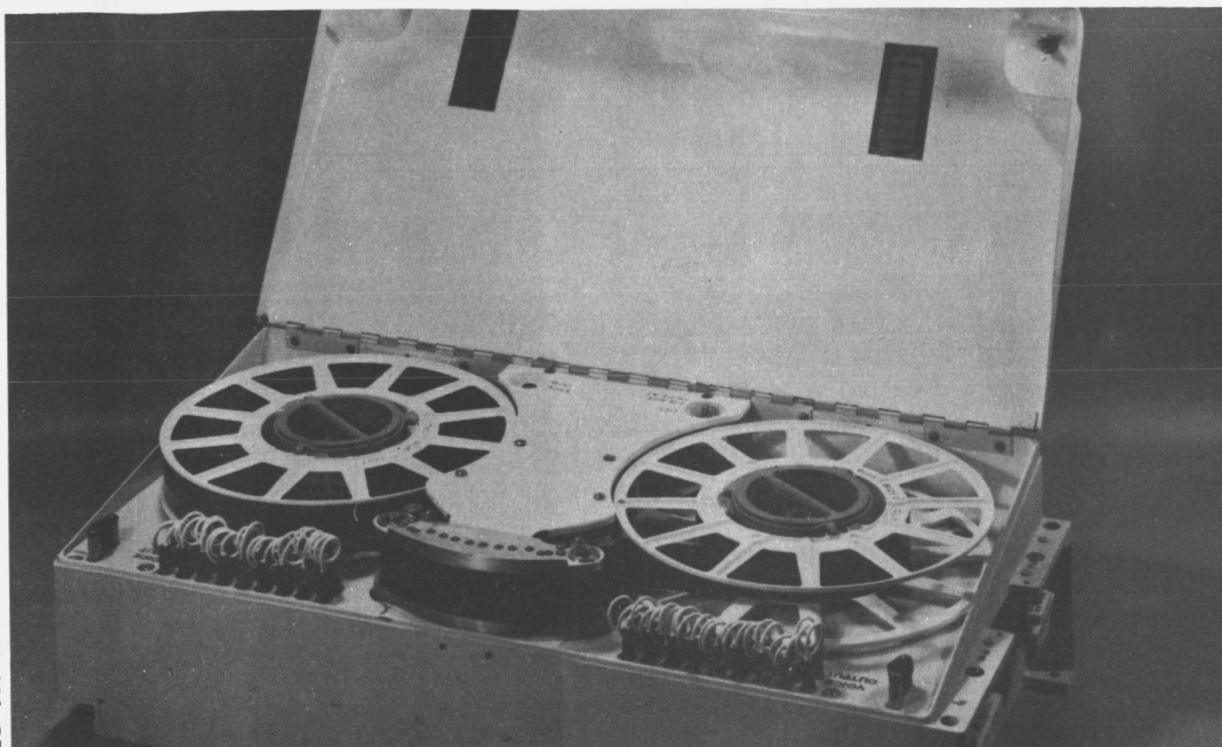


Figure 2. Data Storage Equipment E-Model 1, Tape Transport Side

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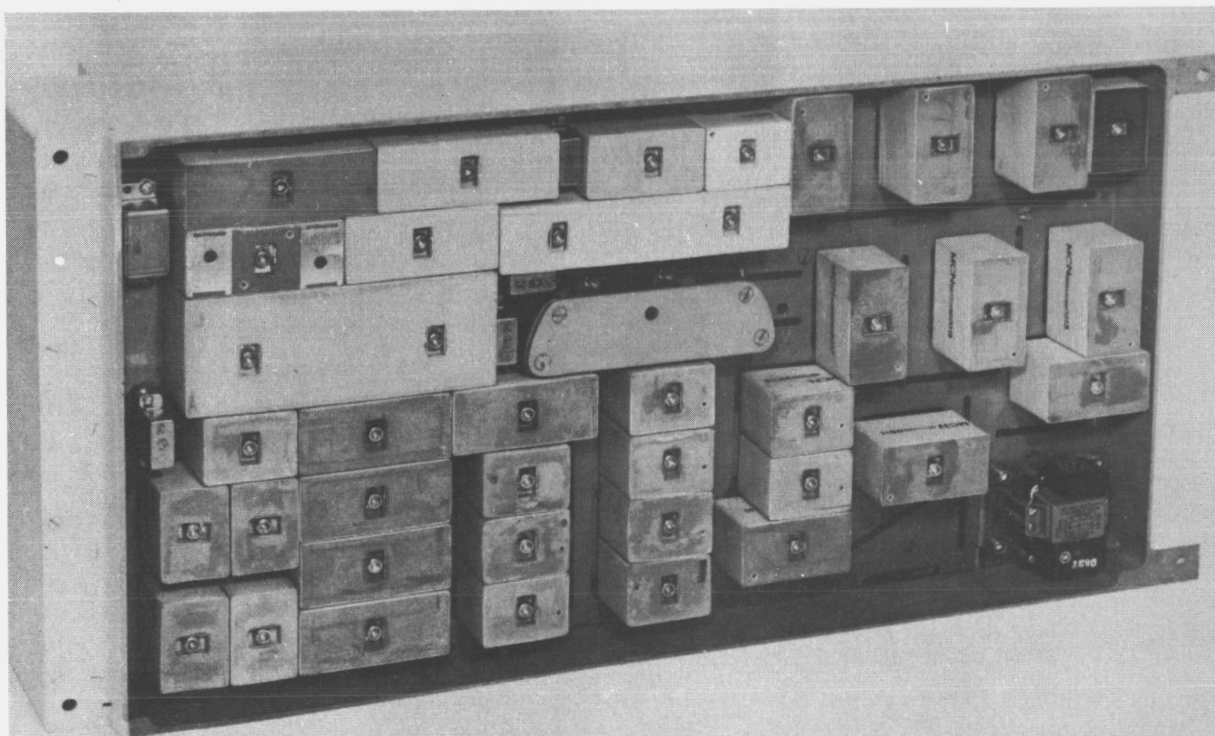


Figure 3. Data Storage Equipment E-Model 1, Electronic Module Side

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22 and 23 and spacecraft 002. Those for spacecraft 012 are being prepared.

Three specific procurement specifications were released for the anthropomorphic dummy application.

All boilerplate 28 camera subsystem procurement specifications were released. This camera will record instrumentation readings and test events.

ENVIRONMENTAL CONTROL SUBSYSTEM

The effect on boilerplate 13 command module cabin air temperature due to the increased leakage area resulting from tower jettison was studied. The analysis indicated that command module air temperature will exceed the 150 F limit at approximately 5 minutes after launch. If the heat exchanger is shut off at launch the cabin temperature will exceed 150 F at approximately 3.5 minutes after launch.

Weather and relative humidity conditions prevailing at Cape Kennedy are being analyzed to detect possible condensation problems. Operating procedures for prelaunch cooling will be established from this analysis to minimize the condensation in boilerplates 13, 15, and 18.

A problem may exist at the water-glycol pump inlet because of air liberation. Tests show that air liberation starts at and above 12.5 psia pump pressure. Glycol used for the test was de-aerated. Increased pump inlet pressure and the use of a more effective method of de-aeration are proposed as solutions.

The ECS radiator test plan is being revised to allow testing of two radiators simultaneously, each subjected to a separate simulated space environment. This simulation will cover a complete earth orbit as well as deep space operation.

An S&ID progress report on the effectiveness and use of operational nuclear radiation detection instrumentation was presented to NASA. A 3-month intensive effort resulted in the following conclusions:

1. A warning of an impending solar proton event, with the use of a radio frequency subsystem, is feasible.
2. An average warning time of 2 hours prior to proton arrival is possible.

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3. The astronauts can take various actions, depending upon the particular mission phases in which they are engaged.
4. In a fully isotropic event, the reorientation of the spacecraft as a result of a warning can reduce the dose received by 17 percent.
5. This reorientation can only be accomplished accurately by using a directional detection instrument.
6. A 70-percent probability exists that the dose will exceed isotropic values unless a directional detection instrument is used. (S&ID recommended procurement of breadboard instrumentation for development of these detection instruments.)

Subsequently, NASA instructed S&ID to proceed with detailed design and procurement of a combined proton direction and external environmental detection system. The first use of flight operational radiation instrumentation will be on spacecraft 021.

Thermal analysis of an inner-structure-to-outer-structure attachment bracket for the command module shows a heat gain of 390 Btu per hour with the current design. A design to reduce this gain by 95 percent is being studied. Analysis indicates that the maximum temperature of the aluminum honeycomb, during the reentry trajectory studied, is 248 F with the present aluminum attachment joint and 120 F with the proposed fiberglass attachment joint.

Thermal analysis of the proposed boost cover and external surface insulation for the command module indicates that a combination of boost cover, insulation, and temperature control coatings will minimize the ECS heat load problem, increase reliability of the heat shield during the cold-soak condition, and substantially reduce the heat shield weight.

The bondline temperature histories of ablative material to stainless steel were computed for five command module bodypoints during a 100-nautical-mile earth orbital decay trajectory. The bondline temperature at three of the bodypoints exceeded the design criterion of 600 F before touchdown.

ELECTRICAL POWER SUBSYSTEM

Tests on the complete cryogenic hydrogen storage tank engineering model 2 (EM-2) revealed a heat leak of 18 Btu per hour, exceeding the

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specified limit of 6.5 Btu per hour. EM-5 will be built to study this heat leak problem. Better tank insulation is being investigated.

A design review of the cryogenic tank fan-heater development program indicates that the basic design is sound. Tests demonstrated that essentially all specification requirements were met and problems were resolved.

The last of three prototype-A power plants passed acceptance tests during this report period. All three will be subject to engineering evaluation tests to be conducted at S&ID.

Extensive power plant tests, system analysis of radiator performance, and vacuum tests with parallel power plant operation for load sharing are in progress. In seven out of twelve starts on one powerplant, procurement specifications were met. Data on fuel cell ac impedance indicate that the dc bus ripple voltage may exceed the specified 250 millivolts. A study is in progress.

Preliminary analyses indicate the feasibility of passively cooling the battery blocking diodes. This would require elimination of the heat-conductive mounting brackets and greater utilization of the thermal storage capacity of the mounting panel and related components.

Because of the large number of intermodular wires, an additional feedthrough to the service module is to be installed in the command module aft bulkhead of spacecraft 013 and subsequent spacecraft to accommodate a total of 1200 wires in addition to 250 wires for use in the command module aft compartment. The existing feedthrough will be used for the command and service module wires on spacecraft 006, 008, 009, 011, and 012.

A Boolean simulation switching study of the service propulsion subsystem gimbal motor electrical power circuit indicates that the circuit will function satisfactorily in all cases considered. However, a minor redesign would be necessary to allow restarting of the gimbal motor after it was turned off due to a failure sensed by the fail-sense unit.

PROPULSION SUBSYSTEM

Service Propulsion Subsystem

During this report period, 56 firings were accomplished in the injector development program. Table 2 lists all firings made during this report period.

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Table 2. Injector Development Test Program, Apollo SPS Engine

Serial Number	Pattern Type	Type of Evaluation	Number of Firings	Number of Unstable Firings	Total Time (sec)	Remarks
AFF-19	POUL-31-16	C* pattern evaluation	3		12	Pattern to be modified
AFF-54	POUL-31-10	C* pattern evaluation	2		11	Satisfactory
		Alternate materials	3		602	Irish Refrasil chamber P_c oscillations, 650 cps
AFF-50	POUL-31-20	C* pattern evaluation	5		28	Satisfactory
		Injector compatibility with chamber	1		30	Satisfactory
		Incremental	4		753	Considerable gouging and streaking
AFF-58	POUL-31-10	C*	2		11	Satisfactory
AFF-59	POUL-31-24	C* pattern evaluation	8		45	Satisfactory
		Incremental duration	7		1,150	Considerable gouging and streaking
AFF-57	POUL-31-10	Balance tests	4		28	Satisfactory
		Acceptance tests	1		30	Satisfactory
AFF-61	POUL-31-26	C*	5		25	Satisfactory
		Injector compatibility with chamber	1		30	Satisfactory
AX-1	POUL-31-18	C* pattern evaluation	5	2	19	To be modified
AX-3	POUL-41-10	C*	3	2	10	To be modified
AFF-24 AEDC 1B	POUL-31-10	Simulated altitude test	5		217	Stainless steel nozzle
AEDC 2A		Simulated altitude test	1		102	Columbium-titanium nozzle extension failed prior to shutdown.
BF-17		Induced stability	2		12	Recovered from 14.5 grain and 36.9 grain charge
C* = Characteristic exhaust velocity						

Testing of the first two all-welded injector assemblies, AX-1 and AX-3, each of which incorporates nine face-feed tubes, was begun. As a result of combustion instability encountered in some of the tests, modifications are under way to obtain a completely stable injector without baffles. 600 seconds were accumulated on injector AFF-54 with an alternate material chamber fabricated of Irish Refrasil. Intermediate frequency oscillations of 560 cycles per second occurred throughout the firings.

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Six simulated altitude firings were conducted at AEDC during this report period. Five firings were made on engine 1B employing a stainless steel nozzle extension to correct test cell difficulties. One firing on engine 2B, using the columbium-titanium nozzle extension, was terminated after 102 seconds because of longitudinal failure of the extension. Test results indicated that redesign is necessary.

Fabrication of the prototype propellant retention reservoir was completed and testing should begin during December after setup and proof-test.

Design layout was started on a test package configuration to observe fluid motion during the orbital flight of boilerplate 15. The design package will accommodate scale model plastic propellant tanks and will include television cameras, lighting, power supply, and a drive mechanism to disturb the fluid.

Definitive contract negotiations were begun for the SPS propellant utilization and gauging subsystem.

Pressure drop and heat transfer tests were conducted on the propellant-helium heat exchangers. The process specifications for the SPS propellant-helium storage and distribution subsystems, for SPS leakage and functional checkout, were released.

A complete review of GSE used for the service propulsion system is in progress to determine capability to meet the operation required by SPS process specifications.

Reaction Control Subsystem

The bladder development program for the RCS positive expulsion propellant tanks is progressing. A minor change was made in the diffuser assembly as the result of a recent bladder failure during dynamic testing. The development verification tests are scheduled to begin in January, and the first RCS propellant tanks should be delivered by the end of the month.

The new larger umbilical to be located on the -Z axis will require relocation of the command module aft pitch engines to approximately 17 degrees on either side of the axis on spacecraft 013 and subsequent vehicles (the present angle is 3.5 degrees on either side of the axis).

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A standard combustion chamber was installed on the flat-face injector of the RCS engine to replace the grit-blast chamber that burned through in a prior test. Tests performed using ambient temperature propellant were almost identical with prior flat-face injector engine tests. During tests with high-temperature propellant, the engine operated in the hot phase for extended periods of time. Analysis of the hot-phase problem is in progress.

Acceptance testing was completed on the first two of ten sea level engines to be delivered to S&ID in partial fulfillment of the Phase-II breadboard and spacecraft 001 requirements.

A test to determine the operating characteristics of the RCS during simulated check valve failures was conducted on the service module RCS breadboard. Preliminary analysis of the data indicates that the simulated failures had little effect on the performance of the over-all system.

Launch Escape Subsystem Motors

Eleven live launch escape motors are now on hand (in addition to the spare motor at WSMR). Only three are at the 31 percent ground oxidizer level considered necessary to meet specifications. Two of these will be fired immediately as preflight rating test motors, and the third will be delivered for use on boilerplate 12. Precise performance predictions for the other motors (28.5 to 30 percent ground oxidizer) were reviewed. At least six, and probably all, of these nine motors must be soaked out and recast in order to provide adequate performance.

The prototype development qualification (PDQ) program for the hotwire cartridge was completed during the report period. The first post-PDQ lot of cartridges showed excessive pressure and was rejected. The cartridges will be reworked to reduce the propellant. Cartridges of the latest design were made available for evaluation in pyrogens.

Vibration testing of tower jettison development motors AD-20 and AD-21 was completed. Motor AD-20 showed no indication of temperature rise. Motor AD-21 showed a substantial (2-degree-per-minute) temperature rise at the off-limit 5-g sinusoidal input, but none at the more reasonable 3-g sinusoidal input.

The boilerplate 6 flight telemetry data analysis indicates that the launch escape and pitch control motor total impulse were very close to

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predicted values. Launch escape motor pressure and thrust were about 8 percent below predicted values. When predicted values are corrected to be consistent with current development test firing data, however, they are consistent with the test results. The boilerplate 6 LES hardware was returned to S&ID from WSMR for engineering inspection and evaluation.

DOCKING AND EARTH LANDING

As a result of the Apollo docking interface panel meeting, the panel recommended that all effort be directed toward development of the center probe and drogue docking concept, contingent upon the development and demonstration of a satisfactory crew transfer capability.

Boilerplate 2 impact drop test 58 was conducted on November 18. This was the first time the four attenuating ribs and the circumferential heat shield attach were drop tested. The Z-Z crew couch attenuation struts stroked more than anticipated while the ribs stroked less, indicating that a less-than-desirable amount of energy was absorbed in structural deformation. The lack of deformation could have been caused by either the ribs or the heat shield.

Boilerplate 2 impact drop test 59 was conducted December 3, with the following impact conditions:

Vertical velocity (V_v) = 24 feet per second
Horizontal velocity (V_h) = 25 feet per second
Pitch = -20 degrees
Roll = 180 degrees
Ground slope = +5 degrees

The vehicle pitched over to the sidewall and considerable headstroke occurred. This resulted in crew couch platform rotation and impact of the crew couch platform on the Z-Z crew couch attenuation struts, probably causing the crew acceleration limit to be exceeded.

Boilerplate 19 drop test 7 was conducted on November 15. The test vehicle was dropped from a C-133 aircraft at an altitude of about 24,000 feet in an apex-forward attitude. The drogue was deployed at 70 psf, 4 seconds after the stabilization chutes disconnected. Oscillations in the pitch plane had damped to about ± 35 degrees at the time of drogue release. The module rotated slowly to an angle of attack of about 90 degrees as the main chute was being deployed. Severe blanketing of the main chutes followed, but they eventually inflated and successfully recovered the boilerplate. Analysis indicates that stability was adequate for the low-probability single-drogue case. Boilerplate 19 overturned after impact in ground winds of about 13 knots because of the lack of a main chute disconnect.

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Boilerplate 19 drop test 8 was conducted on December 5. Test conditions approximated those of high-q abort. The drop was made from the C-133 aircraft at an altitude of 30,000 feet without the apex cover. A 22-foot stabilization chute, deployed by static line from the drop aircraft, stabilized the boilerplate at a 30-degree angle of attack and at approximately 40 psf dynamic pressure. 8 seconds after the stabilization chute disconnected, the 13.7-foot diameter drogue was deployed by mortar at approximately 100 psf dynamic pressure with the boilerplate still in an apex-forward condition. 24 seconds after drogue deployment, the drogue disconnect and pilot mortar fire occurred as planned. One main parachute experienced some aerodynamic blanketing during inflation. Off-the-deck deployment of the main pack appeared uniform. Earth impact of the vehicle was normal.

GROUND SUPPORT EQUIPMENT

Engineering drawings of the following four models of special test unit (STU) equipment were completed on schedule during the report period.

1. Fluid distribution subsystem (FDS) control unit, dimethyl reaction fuel
2. Special test unit G&N
3. FDS control unit, SPS oxidizer fixture 2
4. FDS control unit, SPS fuel fixture 2

A detailed breadboard test program was formulated, including the breadboarding of typical STU circuitry and the associated spacecraft and GSE subsystems. The purpose of this test program is to develop and verify checkout and calibration techniques necessary to measure critical spacecraft parameters.

The PACE spacecraft digital test command system (DTCS) engineering breadboard, for use at S&ID, Downey, was completed. It is undergoing systems test. Procurement steps were initiated for the DTCS prototype and production hardware.

The response subsystem breadboard 1 is scheduled for completion during the next report period, and fabrication of breadboard 2 is 98 percent complete. The first portion of the signal conditioner breadboard, for use at S&ID, Downey, was received. It is now being tested. Response subsystem production drawings should be released by the end of December.

38 drawings were released covering cable subsystems and J-boxes in support of boilerplates 12, 13, and 14. Maximum standardization of cables, connectors, and J-boxes is being incorporated in the design.

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NASA toured the Autonetics facility on November 15, reviewing manufacturing capabilities and the status of the spacecraft instrumentation test equipment (SITE). To incorporate precision ac power supply for SITE and allow adequate future expansion, it will be necessary to increase rack capacity of SITE to 14 cabinets.

The complete tape recorder acceptance test procedures for the ground telemetry station were reviewed. Plans are under consideration to shorten acceptance test time by joint NASA and S&ID witnessing of tape recorder and subsystem electromagnetic interference (EMI) tests.

The hoist beam assembly for the service module and adapter (-101 configuration), end item 3 for boilerplate 9 and end item 4 for boilerplate 13, will be retro-fitted with new serialized sling assembly kits. Analysis of the proof load test failure of the end item 5 sling assembly yoke ring indicated probable difficulties in rings on delivered end items 3 and 4. The questionable rings will be replaced by 25-ton shackles in the new sling assembly kits.

Three RCS propellant transfer units—the RCS oxidizer servicing unit, the RCS service module fuel servicing unit, and the RCS command module fuel servicing unit—will not be available in time to support schedules for boilerplate 14 and spacecraft 001. A substitute engineering test unit with the capability of all three servicing units will be provided.

The GSE liquid hydrogen (LH₂) transfer unit is being modified to provide for the use of helium instead of nitrogen for purging, to meet the need for high-pressure LH₂ for leakage checks and calibration of spacecraft pressure sensors, and to provide for the removal of LH₂ from the spacecraft following an abort. Other changes are the use of KEL-F as seat and packing material in cryogenic valves, the addition of a 5-volt power supply and analog signals to meet PACE and STU requirements, and the use of latching relays in memory circuits only. These changes are in support of boilerplate 14 and spacecraft 001, 006, 009, and 011. The changes will result in greater reliability and increased safety.

SIMULATION AND TRAINERS

An Apollo part-task trainer (APTT) design review briefing was held for NASA on December 3, 4, and 5. The briefing covered missions applicable to the training program, including lunar and mid-course mission requirements, and the selection of computing equipment with associated hardware to be used for simulation of missions. The implemented use of

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the APTT was outlined (Figures 4 and 5). Flight phases and portions of flight phases will be simulated as partial task training. Important task training may be initiated by computer programming for periods up to 2 hours. The physical layout and facility requirements of the computer hardware were presented, including installation, power, and air-conditioning requirements. After the briefing, panel meetings were held on the visual simulation system, malfunction insertion hardware requirements, and computer complex requirements.

PROJECT INTEGRATION

The early concept of a 606-wire cable (umbilical) between the command and service modules is inadequate to meet the increased need in each spacecraft for specific measurement information. An engineering review produced the following decisions:

1. The intermodule cable for spacecraft 006 through 012 will be redesigned to accommodate 1013 wires penetrating the command module heat shield.
2. The intermodule cable for spacecraft 013 and subsequent will be redesigned to accommodate 1200 wires penetrating the command module heat shield.
3. A wire-list will be published and maintained to control the allocation of wires in this cable for each spacecraft affected.

VEHICLE TESTING

The command module of boilerplate 6, used in the pad abort test, is being converted to a multiple air drop configuration test vehicle to replace boilerplate 3 in the continued testing of the parachute recovery subsystem.

All engineering drawings for boilerplate 28 basic structure were completed. This test vehicle was added to the program for land and water impact testing to simulate more closely the spacecraft at impact. In contrast to the overly stiff construction of boilerplates 1 and 2, boilerplate 28 will permit energy absorption by the crushing of the structure, similar to a spacecraft.

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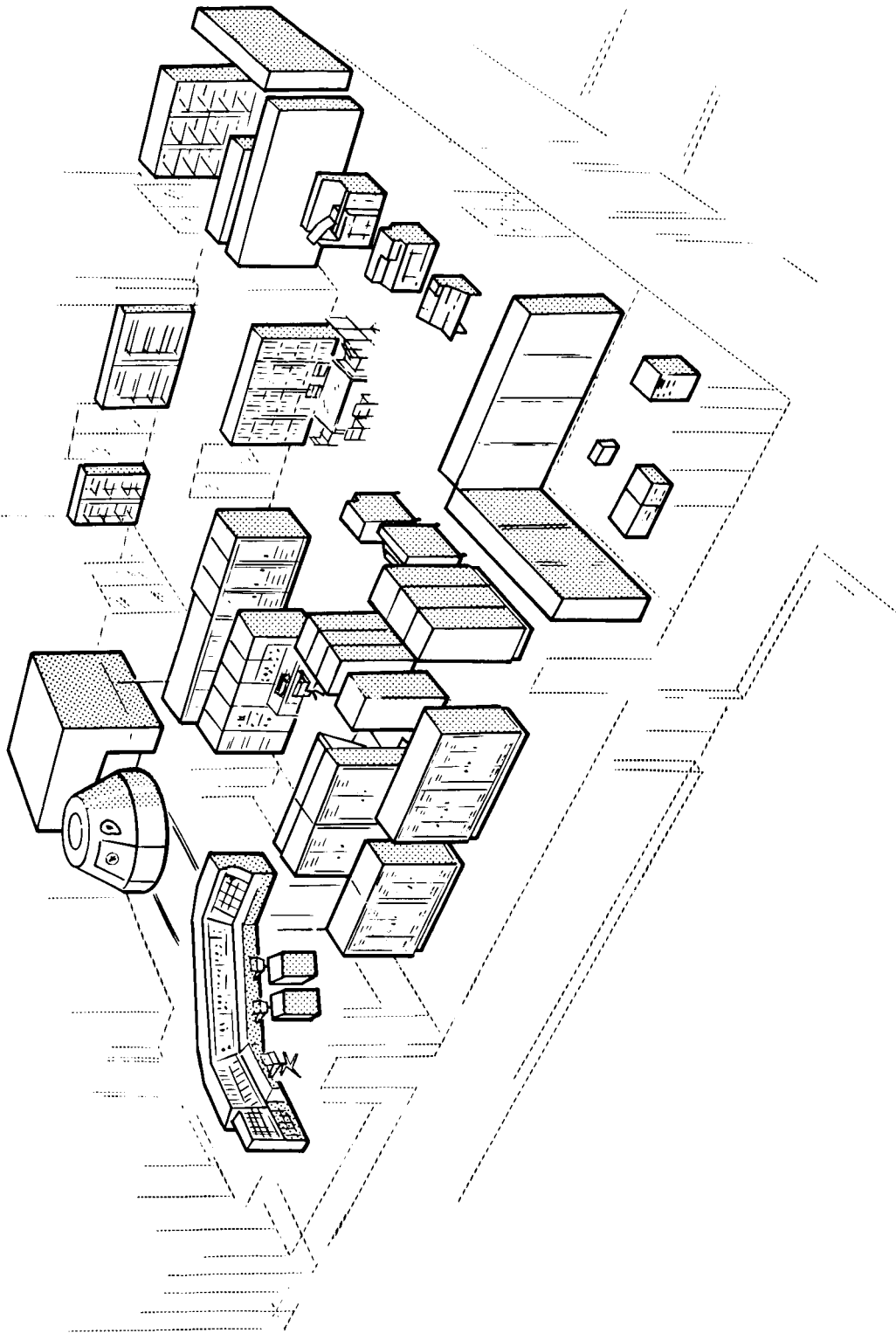


Figure 4. Perspective Layout of Apollo Part-Task Trainer Complex



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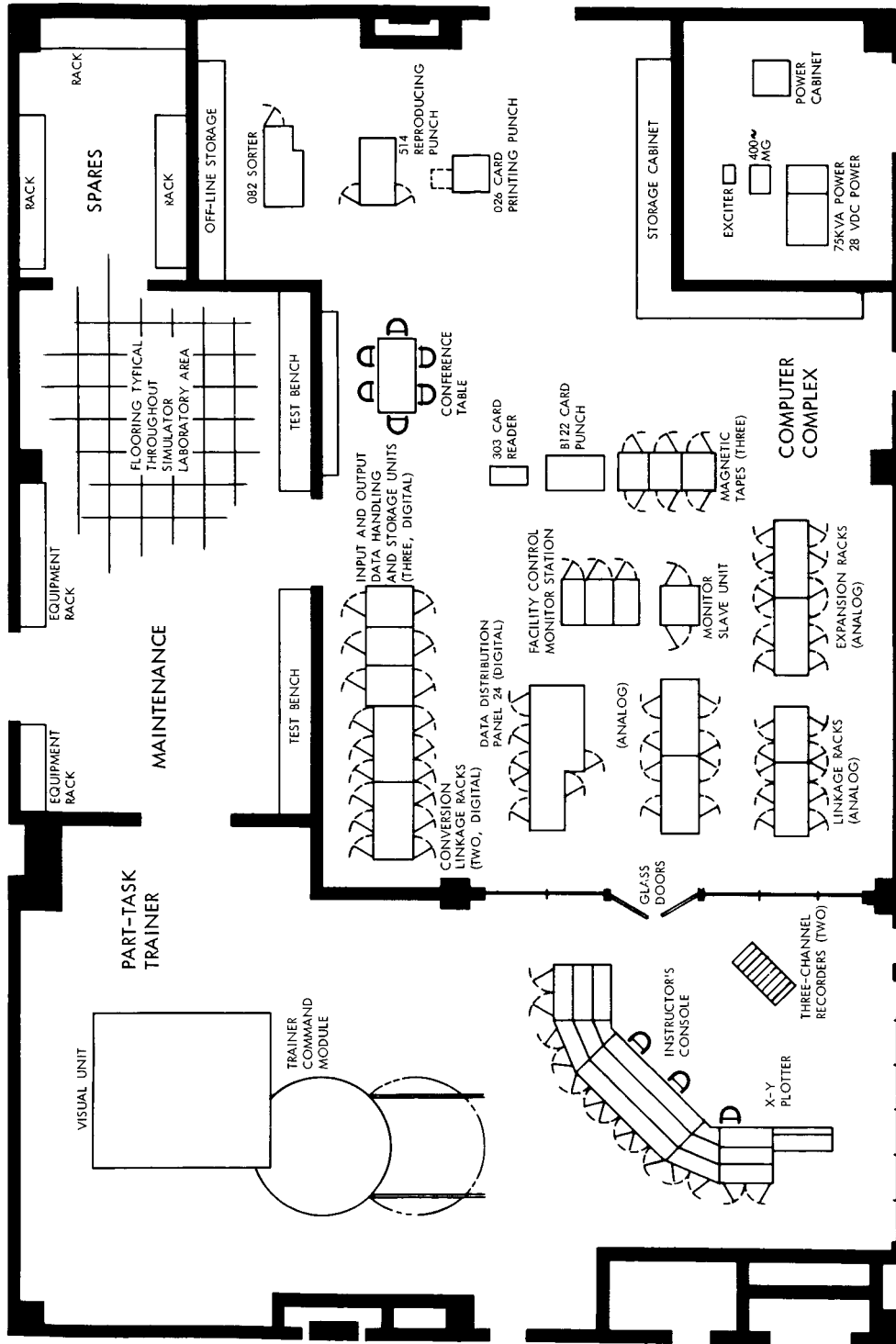


Figure 5. Block Layout of Apollo Part-Task Trainer Complex

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RELIABILITY

S&ID conducted a reliability and quality control symposium for Apollo subcontractors and major suppliers to clarify program requirements regarding identification and traceability, failure reporting, design review, test reports and procedures, quality control problems, supplier surveillance, and inspection and test planning. High reliability and quality, complete data packages, timely documentation and reporting, and close coordination with S&ID were strongly emphasized. In addition, the subcontractors saw publications, films, and guidance material available for motivation of personnel. Similar symposiums are planned in the future, and plans are under way for a symposium for smaller suppliers.

As a result of design reviews of the ECS water-glycol circuit, suit circuit water management system, coldplates, radiators, and associated GSE checkout interfaces, the following actions will be taken:

1. Inconsistency between the operating and proof pressures currently specified in the water management system documents will be corrected.
2. The possibility will be investigated of oxygen being entrained in water condensed within the suit heat exchanger, to be carried into the waste water tank through the automatic waste water recovery system. The accumulation of oxygen in the waste water tank under zero-g conditions would result in erroneous quantity gauging and allow loss of waste water overboard through the 35-psig relief valve. The waste water is needed for evaporative cooling during low radiator emissivity.
3. The ability of the GSE cooling equipment to remove all the air from the command service module glycol circuit during ground cooling operations will be studied. If trapped air remains in the glycol subsystems, complete filling will not be possible, and the trapped air could produce glycol pump cavitation, unnecessary vibration, and serious degradation of the subsystem reliability.
4. The 90-psig checkout pressure supplied by the GSE checkout equipment will be analyzed to determine whether it is satisfactory for all the water-glycol subsystem components. Several components

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currently have a proof pressure considerably lower than the 90-psig GSE checkout pressure. This is being investigated.

5. A temperature sensing flow modulation valve should be installed in the glycol supply line, upstream of the water heater, to assure an adequate flow of coolant to the electronic equipment that requires close temperature control under all coolant temperatures and flow rates. A study is in process on the flow and distribution of the glycol circuit using fixed orifices for the temperature control and fluid flow control to the electronic coldplates. Close temperature control may be difficult with fixed orifices, however, because of the extreme flow conditions that can exist throughout all operating modes of the ECS. For this reason, a thorough analysis will be made. Consideration of a modulating flow control valve to the inertial measurement unit (IMU) should be deferred until this analysis is complete.
6. Installation will be evaluated of an electric heat exchanger in the glycol circuit, downstream from the coldplates, to offset reduced heating effect when the coldplate equipment electronic loading is low.
7. Installation will be studied of additional temperature sensors in mission-essential and crew safety electronic equipment to indicate individual coldplate temperature through a single display connected with a selector switch. These sensors would enable the crew to take corrective action before a malfunction could occur.
8. A list will be prepared of the critical components essential to the mission and their respective maximum operating temperatures. This list will be used to determine whether mission-essential equipment can be located in a glycol loop and isolated in case of a leak or restriction in the nonessential coldplate glycol loop.

TECHNICAL OPERATIONS

Changes are in process on the emergency detection subsystem (EDS) to permit interface connections between the spacecraft and the

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booster portions of the S-I crew safety subsystem EDS. The automatic abort and engine shutdown functions of the EDS are being changed from a coldwire redundant system to a hotwire two-out-of-three voting system. These changes are effective on boilerplates 14 and 18. On spacecraft 006, 008, 009, 011, 012, and 014, and on GSE models A14-016, A14-062, and A14-612.

A redesign of the command module RCS fuel, oxidizer, and helium panels is being made to enable acceptance of actual components being supplied and to permit arming with initiators without the necessity of removing the heat shield. This change will be effective on boilerplates 14 and 22 and on spacecraft 002, 006, 008, 009, and 011.

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OPERATIONS

DOWNEY

The launch tracking data for boilerplate 6 have been processed with the use of corrected meteorological data. Recordings of acceleration, motor pressure, and surface pressure transducer data with any unusual characteristics, made by the on-board recorder, are being compared with the four radio-frequency telemetry data tapes.

The command module, command module apex covers, service module, service module adapter, and launch escape tower of boilerplate 12 have been accepted from S&ID Manufacturing. The modifications and rework have been started.

Installation of instrumentation on boilerplate 12 (the temperature simulator box, the signal conditioning box, and the low-level commutator) is continuing.

The stacking of the command module and service module of boilerplate 12 for a check of the vertical alignment has been completed.

A dry-run simulation of the boilerplate 12 operation has been performed, utilizing the interim data station and the telemetry ground station in order to acquaint S&ID personnel with their operational capabilities.

The command module, service module, and adapter of boilerplate 13 were accepted from S&ID Manufacturing.

Acceptance testing has been completed for the telemetry ground station tape recorder reproducers. NASA Quality Control has released an interim acceptance in order that data handling for boilerplates 12 and 13 would not be delayed.

During the next report period, test preparation and checkout will be completed for boilerplates 12 and 13, and they will be prepared for shipment.

The detailed test plan and the operational test plan for boilerplate 23 will be prepared during the next report period.

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WHITE SANDS MISSILE RANGE

The 48-hour pressure maintenance checkout is continuing on test fixture F-2 at the propulsion systems development facility (PSDF). The rework of the test fixture mounting ring pads has been completed, and the flatness of each pad has been verified by optical methods. The mounting ring has been installed and leveled.

The data acquisition system for the PSDF has passed the in-house and the S&ID plant acceptance testing. The system has been shipped to WSMR.

The WSMR mission abort blockhouse J-box, the checkout trailer, and the weight and balance fixture alignment will be completed during the next report period. Test fixture F-2 will be moved to the test stand at the PSDF and installed. Transducer cabling will be installed.

FLORIDA FACILITY

Operation Scramble, a simulation of the spacecraft off-loading operation at the Florida Facility, was concluded with a critique on December 6, 1963. The operation provided training for the boilerplate 13 test program.

The prelaunch automatic checkout equipment (PACE) up-link and down-link breadboards for computer programming are undergoing debugging. The guidance and navigation digital test command system, the command up-link electronics (CUE) module, and the down-link decommutator simulator program have all been exercised. The problem areas uncovered are being resolved.

A dry-run of the PACE up-link breadboard Phase-C test procedure has been completed to check the rough draft for errors.

The detailed test plan for boilerplate 15 has been published and distributed.

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FACILITIES

DOWNEY

Systems Integration and Checkout Facility

The bench maintenance area of the systems integration and checkout facility will be available for occupancy during the next report period. The total building is approximately 74 percent complete (see Figure 6).

Space Systems Development Facility

The Electrical Power System and Environmental Control System portion of the space systems development facility is complete. The engineering development laboratory occupied the ECS Control Room area December 7. The main portion of the building is approximately 40 percent complete (see Figure 7).

Data Ground Station

Under-floor conduit and wiring and return air duct work on the data ground station were completed during the report period, and installation of the elevated floor system was begun.

INDUSTRIAL ENGINEERING

GFY 1964 Appendix A

Volume I, Brick and Mortar, and Volume II, Machinery and Equipment, were submitted to NASA during the report period.

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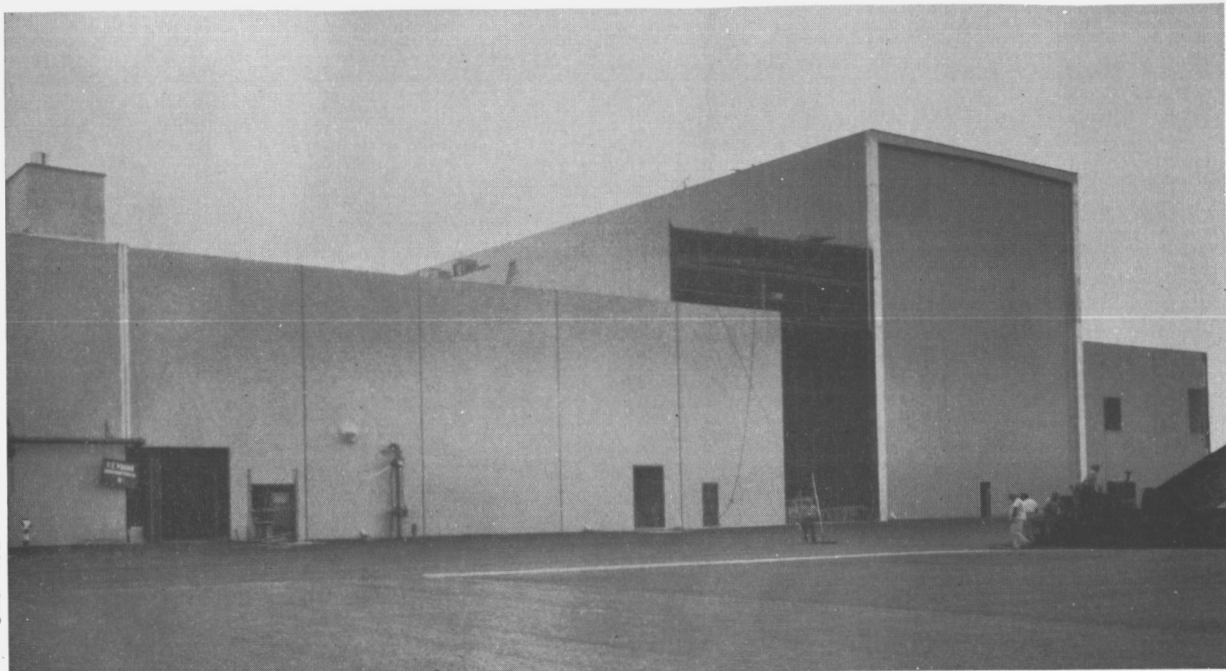


Figure 6. Systems Integration and Checkout Facility

SID-820-23 F



Figure 7. Space Systems Development Facility

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APPENDIX

S&ID SCHEDULE OF APOLLO MEETINGS AND TRIPS



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S&ID Schedule of Apollo Meetings and Trips
November 16 to December 15, 1963

Subject	Location	Date	S&ID Representatives	Organization
GSE schedule proposal	Houston, Texas	November 16	Stevens	S&ID, NASA
Electrical systems meeting	Houston, Texas	November 17 and 18	Crawford, White, Robinson	S&ID, NASA
Common usage requirements coordination	Bethpage, Long Island, New York	November 17	Crisell, Samuelson	S&ID, Grumman
Aerodynamic static force tests	Mountain View, California	November 17	Cameron	S&ID, Ames Research Center
Electrical systems integration panel meeting	Huntsville, Alabama	November 18	Crawford, White, Robinson	S&ID, NASA
CM-RCS Engineering conference	Hampton, Virginia	November 18	Lofland	S&ID, Langley Field
Propulsion systems meeting	Houston, Texas	November 18	Field	S&ID, NASA
Design activities coordination	Sacramento, California	November 18	Mower	S&ID, Aerojet-General
Apollo test data meeting	Florida Facility	November 18	Wellens, Dorsey, Schwarzmann	S&ID, NASA
Gases and propellants subpanel meeting	Florida Facility	November 18	Yim, Grycel, Randall, Dunzer	S&ID, NASA
Field survey	Tarrytown, New York	November 18	Bratfisch	S&ID, Simmonds Precision
Aerodynamic static force tests	Mountain View, California	November 18	Donovan	S&ID, Ames Research Center
PSTL 2, static pressure tests	Mountain View, California	November 18	Snowden	S&ID, Ames Research Center
Apollo wind tunnel program coordination	Houston, Texas	November 18	Allen	S&ID, NASA
NASA, NAA, and MIT G&N coordination meeting	Cambridge, Massachusetts	November 18	Kennedy, Zeitlin, Beck, Richie, Thomas, Kasten	S&ID, MIT
B-13 instrumentation system	Florida Facility	November 18	Barmore, Beason	S&ID, NASA
Docking interface panel meeting	Houston, Texas	November 18	Neatherlin, Gustavson Lusk, Brewer, Stefan	S&ID, NASA
Resident project engineer at Aerojet-General, Apollo program	Sacramento, California	November 18	McNamara	S&ID, Aerojet-General

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S&ID Schedule of Apollo Meetings and Trips
November 16 to December 15, 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
SCS BME status review	Minneapolis, Minnesota	November 18	Hindi	S&ID, Honeywell
Observe NAA-NASA Apollo centrifuge program	Johnsville, Pennsylvania	November 19	Hufford	S&ID, Martin
Apollo SCS design support	Minneapolis, Minnesota	November 19	Frankos	S&ID, Honeywell
PCM telemetry equipment coordination meeting	Melbourne, Florida	November 19	Rosenthal, Dorrell, Whitehead, Rose	S&ID, Radiation
Status review and buy-off meeting	Minneapolis, Minnesota	November 19	Colaanni, Wessling	S&ID, Honeywell
Hardware acceptance procedure coordination	Minneapolis, Minnesota	November 19	Dyson, Whitehorn	S&ID, Honeywell
Honeycomb panels progress review and report	Middletown, Ohio	November 19	Smith	S&ID, Aeronca
BME coordination meeting	Cedar Rapids, Iowa	November 19	Marine	S&ID, Collins Radio
Profit factors	Houston, Texas	November 19	Drucker	S&ID, NASA
PERT coordination	Hartford, Connecticut	November 19	Czerwonky	S&ID, Pratt & Whitney
Heatshield Manufacturing schedules review	Middletown, Ohio	November 19	Daily	S&ID, Aeronca
Structural stiffness requirements	Houston, Texas	November 19	Tutt	S&ID, NASA
PERT	E. Hartford, Connecticut	November 19	Nash, Young, Czerwonky	S&ID, Pratt & Whitney
Boilerplate 12 integrated schematics	Las Cruces, New Mexico	November 19	Garcia, Mattson	S&ID, NASA
S&ID, MIT, and NASA coordination meeting	Boston, Massachusetts	November 19	Frost	S&ID, MIT, NASA
Fuel cell review and examination	Milwaukee, Wisconsin	November 20	Pohlen	S&ID, Allis-Chalmers
Apollo G&N systems panel meeting	Houston, Texas	November 20 and 21	Louie, Kennedy, Niemand, Palmer, Johnson, Knotts	S&ID, NASA
GSPO meeting	Houston, Texas	November 20	Covington	S&ID, NASA

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S&ID Schedule of Apollo Meetings and Trips
November 16 to December 15, 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Manufacturing and handling procedures review	Middletown, Ohio	November 20	Stover, Confer, Harrison	S&ID, Aeronca
Technical coordination on revision C of specification	Joplin, Missouri	November 20	Otzinger, DeVries, Meurisse	S&ID, Eagle-Picher
Delivery schedule review	Middletown, Ohio	November 20	Stover	S&ID, Aeronca
Quarterly management briefing	Elkton, Maryland	November 20	Reed, Yee, Leonard Brauel	S&ID, Thiokol
Apollo SCS design status report	Minneapolis, Minnesota	November 20	Levine, McCarthy, Peterson, Antletz, Watson	S&ID, Honeywell
GOSS performance problems briefing presentation	Greenbelt, Maryland	November 20	Ruggiero	S&ID, NASA
Quarterly management meeting	Elkton, Maryland	November 20	Yee, Babcock	S&ID, Thiokol
Phase I facility checkout test firing evaluation	Tullahoma, Tennessee	November 20	Cadwell, Hackett	S&ID, AEDC
LEM GSE policy and procedure meeting	Houston, Texas	November 20	Schauers, Richardson	S&ID, NASA
Agenda Simmonds meeting	Tarrytown, New York	November 20	Stevens	S&ID, Simmonds Precision
Apollo wind tunnel test	Moffet Field, California	November 20	Mooney, Molinaro, Schroeder	S&ID, Ames Research Center
Apollo survival equipment review	Sausalito, California	November 21	Smith	S&ID, Survival Equipment
PACE breadboard signal conditioner review	Seattle, Washington	November 21	Hirata, Williamson	S&ID, Electro Development
Resident project engineer at Aerojet-General (Apollo program SPS)	Sacramento, California	November 21	Borde	S&ID, Aerojet-General
IBM program discussion	Cleveland, Ohio	November 22	Dunkovich, Duncan	S&ID, NASA
Umbilical hose and connector demonstration and discussion	Bethpage, Long Island, New York	November 22	Brewer	S&ID, Grumman

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S&ID Schedule of Apollo Meetings and Trips
November 16 to December 15, 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Quarterly management meeting	Elkton, Maryland	November 22	Greco	S&ID, Thiokol
Single channel decommutator testing	Melbourne, Florida	November 22	Symm	S&ID, Radiation
Simulation of entry tasks and profile support	Johnsville, Pennsylvania	November 24	Hornick, Sargent, Russell	S&ID, AMAL
Boilerplate 13 and 15 critical shortage equipment items	Bayshore, Long Island, New York	November 24	Keith	S&ID, Fairchild Stratos
Umbilical hose interface demonstration and discussion	Bethpage, Long Island, New York	November 24	Roebuck, Roentgen	S&ID, Grumman
Coordination of test requirements	Minneapolis, Minnesota	November 24	Wimple	S&ID, Honeywell
RCS and SPS checkout and static firing requirements	Florida Facility	November 24	Fuller, Stevens, Monroe	S&ID, NASA
Discussion of IMCC and AMS equations	Binghamton, New York	November 24	Flatto, Meston	S&ID, General Precision
Airframe 002 and 010 instrumentation system design meeting	Houston, Texas	November 24	Marks, Megas, Eckmeier, Nickols	S&ID, NASA
Current developments in bioinstrumentation and checkout procedures review	Houston, Texas	November 25	Raggio, Atlas	S&ID, NASA
Service propulsion system support	Las Cruces, New Mexico	November 25	Bauserman	S&ID, NASA
Inconel 718 forgings coordination meeting	Houston, Texas	November 25	Krainess	S&ID, Cameron Iron
FS-3 wind tunnel tests	Tullahoma, Tennessee	November 25	Daileda	S&ID, AEDC
Acceptance tests on explosive bolt evaluation	Mesa, Arizona	November 25	Fisher	S&ID, Talley
Cryogenic storage system fan motor design review	Dayton, Ohio	November 25	Quebedeaux, Fono	S&ID, Globe
Cryogenic fuel cell system, discussion of cleanliness requirements	Boulder, Colorado	November 26	Nash	S&ID, Beech

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S&ID Schedule of Apollo Meetings and Trips
November 16 to December 15, 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Engine testing and design activities coordination	Sacramento, California	December 1	Mower	S&ID, Aerojet-General
PSTL 2, static pressure tests	Mountain View, California	December 1	Snowden, Blystone	S&ID, NASA
Static force tests	Mountain View, California	December 1 and 2	Cameron, Donovan	S&ID, Ames Research Center
Simulation of entry tasks and profile support	Johnsville, Pennsylvania	December 1	Hornick, Sargent	S&ID, AMAL
Boilerplate 13 countdown coordination	Florida Facility	December 2	Linsday	S&ID, NASA
Wind tunnel pre-test conference	Buffalo, New York	December 2	Biss	S&ID, Cornell Aeronautical Laboratory
Quotation for space-craft 12 through 27 field analysis	Middletown, Ohio	December 2	Stover	S&ID, Aeronca
Apollo communications and data systems coordination	Cedar Rapids, Iowa	December 2	Moore	S&ID, Collins Radio
Field analysis	Middletown, Ohio	December 2	Peterson	S&ID, Aeronca
Operation scramble, preparation	Florida Facility	December 2	Harvey	S&ID, Florida Facility
Honeycomb panel manufacturing, hours analysis	Middletown, Ohio	December 2	Smith	S&ID, Aeronca
Management coordination	Azusa, California	December 3	Hagelberg, Pope	S&ID, Leach
Apollo management coordination meeting	Phoenix, Arizona	December 3	Hagelberg, Pope	S&ID, Motorola
Functional model B component, acceptance test	Minneapolis, Minnesota	December 3	Fiore, Jarvis	S&ID, Honeywell
Heat shield testing and design meeting	Wilmington, Massachusetts	December 3	Statham, Mahurin, Monda	S&ID, Avco
Wind tunnel tests and pre-test conference for heat transfer tests	Buffalo, New York	December 3	Scottoline	S&ID, Cornell Aeronautical Lab
Boilerplate 12 GSE verification requirements document	Las Cruces, New Mexico	December 3	McFarland	S&ID, NASA

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S&ID Schedule of Apollo Meetings and Trips
November 16 to December 15, 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Monthly coordination meeting	Rolling Meadows, Illinois	December 3 and 4	Greenfield, Schiavi Banta, Covington	S&ID, National Watch
SCS system test procedure review	Minneapolis, Minnesota	December 4	Mahan	S&ID, Honeywell
S&ID facilities requirements review	Washington, D. C.	December 4	Mundy	S&ID, NASA
Monitor contract until first anthropomorphic dummy is delivered to NAA	Long Island City, New York	December 4	Flegal	S&ID, Alderson Research Laboratory
Fact-find the reasons for requested increase in overhead and G&A billing rates	Rolling Meadows, Illinois	December 4	Banta	S&ID, Elgin
Trajectory meeting presentation and discussion of IMCC and AMS equations	Binghamton, New York	December 4	Flatto, Meston	S&ID, General Precision
Flight technology systems meeting	Houston, Texas	December 4	Dodds, Canetti, Helms, Moote, Moore	S&ID, NASA
PACE signal conditioner discussions	Houston, Texas	December 4	Sutherland	S&ID, NASA
Parachute drop test observation and monitoring	El Centro, California	December 4	Young	S&ID, NASA
Program design review meeting, S&ID-Aerojet management meeting	Sacramento, California	December 4 and 5	Field, Cadwell, Ross	S&ID, Aerojet-General
Boilerplate 19 modification	El Centro, California	December 5	Bean, Gibbs, Juarez	S&ID, USN
NAA AGC management meeting	Sacramento, California	December 5	Briggs, Flynn	S&ID, Aerojet-General
PERT microfilming, reproduction method evaluation	Houston, Texas	December 5	Palmer	S&ID, NASA
Gases and propellants subpanel meeting	Florida Facility	December 5	Harvey, Wright Grycel, Randall, Dunzer, Yim, Janus	S&ID, NASA
Propellant weighing, meeting	Houston, Texas	December 5	Hillberg	S&ID, NASA

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S&ID Schedule of Apollo Meetings and Trips
November 16 to December 15, 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Engine tests for CM and SM RCS test	Tullahoma, Tennessee	December 5	Mora	S&ID, NASA
SCS weights coordination meeting	Minneapolis, Minnesota	December 6	Gasparre	S&ID, Honeywell
Definitive negotiations	Scottsdale, Arizona	December 8	Hagelberg, Blakeley	S&ID, Motorola
Dynamic stability model FD-6 tests	Mountain View, California	December 8	Allen, Takvorian, Udvardy	S&ID, Ames Research Center
BME philosophy presentation	Houston, Texas	December 8	Donaldson, Gibb	S&ID, NASA
CM material problems, discussion	Cedar Rapids, Iowa	December 8	Kurtz	S&ID, Collins Radio
Soldering specification discussions	Houston, Texas	December 8	Charnock, Lawrence	S&ID, NASA
Communication and instrumentation subsystem panel meeting	Houston, Texas	December 8 to 10	Page, Hall, Tyner, Cason	S&ID, NASA
PSDF ICD submittal for review	Las Cruces, New Mexico	December 8	Suddarth, Brilliant Ragusa, Markel	S&ID, NASA
Engineering support during up-data link contract negotiations	Scottsdale, Arizona	December 8	Blakeley, Covington, Shear, Fuller, Hagelberg	S&ID, Motorola
Simulation of Apollo attitude control system review	Minneapolis, Minnesota	December 8	Morse, Lum	S&ID, Honeywell
Auxiliary ECA acceptance testing	Minneapolis, Minnesota	December 9	Jandrasi	S&ID, Honeywell
Monthly coordination meeting and quarterly management briefing	Boulder, Colorado	December 9 and 10	Champaign, Jorgensen, Kinsinger	S&ID, Beech
Wind tunnel tests on FS-3 model	Tullahoma, Tennessee	December 9	Daleda	S&ID, AEDC
Positive expulsion tank review	Buffalo, New York	December 9	Hobson, Whiting	S&ID, Bell
Lunar mission design plan, discussion	Houston, Texas	December 9	Sherman, Cole	S&ID, NASA
Ablative heat shield performance presentation	Houston, Texas	December 9	Gershun	S&ID, NASA
GSE work group meeting	Cambridge, Massachusetts	December 9	Kasten, Gresham, Williamson, Fries, Chriske	S&ID, MIT

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S&ID Schedule of Apollo Meetings and Trips
November 16 to December 15, 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
ECS panel meeting	Houston, Texas	December 9 and 10	Stelzriede, Laubach, Paulsen, Petrey	S&ID, NASA
Design review	Cincinnati, Ohio	December 9	Cass, Lindsay	S&ID, KECO
GSE coordination meeting	Cedar Rapids, Iowa	December 9	Marine, Griffiths, Milham, Rourke	S&ID, Collins
F-2 test program coordination	Las Cruces, New Mexico	December 9	Bauserman	S&ID, NASA
Acceptance tests	Minneapolis, Minnesota	December 9	Garcia	S&ID, Honeywell
Quarterly program management briefing	Boulder, Colorado	December 10	Carter, Westfall, Haglund, Collins Bouman, Pohlen	S&ID, Beech
Monthly coordination meeting	Lima, Ohio	December 10	Webb, Milliken, Vermill	S&ID, Westinghouse
Vibration measurement system evaluation program coordination	Seattle, Washington	December 10	Harms, Ullery	S&ID, Boeing
Dynamic stability model FD-6 tests	Mountain View, California	December 10	Vardoulis	S&ID, NASA
Technical review of program	Tarrytown, New York	December 10	Bankson	S&ID, Simmonds Precision
Coordination meeting	Florida Facility	December 10	Leine	S&ID, NASA
RCS engine tests	Tullahoma, Tennessee	December 10	Brandel, Gunter, Miyakawa	S&ID, AEDC
Boilerplate 19 modification	El Centro, California	December 11	Bean, Gibbs	S&ID, USN
Potential supplier survey	Roseland, New Jersey	December 11 and 12	Sass, Butler, Burge, Spritzler	S&ID, Resistoflex
Design review conference	Raleigh, North Carolina	December 11	Scott	S&ID, Electric Storage Battery
Coordination meeting	Princeton, New Jersey	December 11	Gill, Leffler	S&ID, RCA
Technical interchange meeting	Boulder, Colorado	December 11	Bojic	S&ID, Beech
RFI shielded enclosures meeting	Huntsville, Alabama	December 11	Wong	S&ID, NASA
Drop test vehicle modification planning meeting	El Centro, California	December 11	Rodier, Trebes	S&ID, USN

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S&ID Schedule of Apollo Meetings and Trips
November 16 to December 15, 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Tunnel facilities coordination	Tullahoma, Tennessee	December 11	Cadwell, Koppang	S&ID, AEDC
Engineering coordination meeting	Princeton, New Jersey	December 11	Gill, Moreno	S&ID, RCA
Design review meeting	Raleigh, North Carolina	December 11	Otzinger, Lowry	S&ID, Electric Storage Battery
Common usage interface information for discussion	Houston, Texas	December 11	Schauers	S&ID, NASA
GSE support of handling and auxiliary equipment	Las Cruces, New Mexico	December 11	Frank	S&ID, NASA
Space simulator coordination	Houston, Texas	December 12	Dorian	S&ID, NASA
Electrical umbilical connector interface meeting	Houston, Texas	December 12	Dziedziula, Atlas, Hayes	S&ID, NASA
ICD on permanent piping discussion	Huntsville, Alabama	December 12	Barajas, Gosting	S&ID, NASA
RCS engine tests	Tullahoma, Tennessee	December 13	Rivera	S&ID, AEDC
Investigation of proposal	Cedar Rapids, Iowa	December 15	Hagelberg, Doll	S&ID, Collins Radio

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